

Research Article

Cardiovascular Risk Factors in a Suburban Community in Nigeria

Titilope Modupe Dokunmu,^{1,2} Omolara Faith Yakubu,^{1,2} Abiodun Humphrey Adebayo ,^{1,2} Grace Iyabo Olasehinde,^{2,3} and Shalom Nwodo Chinedu^{1,2}

¹Department of Biochemistry, Covenant University, Ota, Nigeria

²Covenant University Public Health and Wellbeing Research Group (CUPHWERG), Ota, Nigeria

³Department of Biological Sciences, Covenant University, Ota, Nigeria

Correspondence should be addressed to Abiodun Humphrey Adebayo; abiodun.adebayo@covenantuniversity.edu.ng

Received 18 October 2017; Revised 10 February 2018; Accepted 25 February 2018; Published 1 April 2018

Academic Editor: Srinivas Nammi

Copyright © 2018 Titilope Modupe Dokunmu et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The burden of hypertension, a silent killer, continues to increase in low- and middle-income countries. This study evaluated blood pressure (BP) in healthy adults to determine their risk of developing hypertension and to reduce associated morbidity of the disease. Overall, 182 subjects aged >16 years participated in the study. Systolic (SBP) and diastolic blood pressure (DBP) was measured after a resting period using mercury sphygmomanometer. Random blood glucose (RBG) concentration was also determined. Regression models were used to determine risk of high BP with p values < 0.05 indicating statistical difference. Prehypertension was present in 36.8% population and high BP in 31% individuals with hypertensive symptoms. DBP \geq 90 mmHg was prevalent in the undiagnosed group, while diabetes comorbidity was detected in only 4 individuals. High BP or diabetes was not detected in those <20 year olds. Age > 35 years was an independent risk (likelihood ratio: 22.56, $p < 0.0001$); this increases to 26.48 ($p < 0.0001$) in the presence prediabetes and RBG > 100 mg/dl. Undiagnosed hypertension rate is high in the study area, and urgent interventions for large scale screening and management of the disease are required to reduce the burden of hypertension in Nigeria.

1. Introduction

The burden of noncommunicable diseases (NCDs) has increased in developing countries over the past decade and majority of deaths occurred in low- and middle-income countries (LMIC) [1, 2]. About 16 million people die prematurely annually from preventable NCDs, the impact of which can be lessened by reducing the risk factors associated with these diseases [3]. Diabetes and hypertension are two prevalent metabolic and leading risk factors for cardiovascular diseases, which rank the highest among the causes of mortality associated with noncommunicable diseases in Africa [3–8]. Diabetes mellitus, a chronic health condition that causes high blood sugar levels due to poor insulin production or poor utilization by the body [9], often coexists with hypertension (a systolic blood pressure \geq 140 mmHg or diastolic blood pressure \geq 90 mmHg), because they share

common disease mechanisms; one condition exacerbates the other [10–12] although this may not always be the case [13]. The global incidence of diabetes mellitus increased in the past few decades from 108 million in 1980 to 422 million in 2014 [2] and people with uncontrolled hypertension rose from 600 million in 1980 to nearly 1 billion in 2008 [3, 4]. The highest incidence of diabetes and hypertension occurring in developing countries [2, 14, 15] has been attributed to population growth, ageing, and modernization [16].

Majority of adults (>25 years of age) are affected with these conditions and are oblivious of it; this often results in complications such as cardiovascular diseases, kidney failure, stroke, blindness, and nerve damage [2, 17–19], thus increasing the risk of deaths attributable to NCDs which is projected to rise rapidly by 2030 [3, 4, 14]. Diabetes mellitus and hypertension are often asymptomatic and undetected such that many people living with these conditions are oblivious of

it [20]. Diagnosis is usually done when pathological and functional damage have progressed, thus resulting in complications and high death rates attributable to these diseases [3, 4, 6, 7, 10, 21]. Prediabetes (impaired fasting glucose and glucose tolerance) precedes the onset of diabetes, while raised blood pressure precedes hypertension; early detection and timely treatment of diabetes and hypertension are an important strategy that can be utilized in poor resource countries where NCD disease burdens are high. Studies have shown that diabetes and hypertension can be prevented or managed with drugs and lifestyle modification, thus reducing the disease burden and its sequelae [22–24]. Detection of prediabetes and prehypertension to determine persons at risk of the diseases is critical for early management and prevention of these diseases. Global prevalence of diabetes is 10% and has been on the increase in LMIC and 40% incidence of hypertension was reported in 2008 with the highest prevalence occurring in Sub-Saharan Africa; however, the prevalence varies widely across countries and regions [4, 5, 8, 25, 26]. In Nigeria, the reported prevalence of diagnosed diabetes mellitus ranges between 4.6–25% and 25–54% for hypertension, and there is a large population of undiagnosed cases [2, 11, 27–31]. In recent times, there are few studies evaluating the risks and predisposition to or early detection of hypertension and diabetes comorbidity especially in community settings in Nigeria and it has become imperative to reduce the increasing burden of cardiovascular diseases [32–34]. This study evaluates the prevalence of prehypertension and the risk of hypertension in apparently healthy adults living in semiurban communities in Nigeria where access to robust health care services is expensive and NCDs prevalence is high. The study was a cross-sectional survey which evaluated prehypertension or hypertension in healthy participants aged >16 years.

2. Methods

2.1. Study Area. The study was carried out in two suburban communities in Ota, southwest Nigeria, in April 2016 where a voluntary health survey was carried out. Ota is a populous city with a population size of over 160,000 residents. Informed consent was obtained from the participants of the study. The community leader was sought for permission and ethical approval was given by Covenant University Health Research Ethics Committee and local authority.

2.2. Study Population. The inclusion criteria for selecting the study participants were individuals who aged between 16 and 95 years, were nonpregnant, nondiabetic, or nonhypertensive, and were not under treatment for any of the conditions in the past two weeks and apparently healthy individuals who were willing to participate in the study. Persons with known chronic diseases and those who are ill and on antihypertensive or antidiabetic medication or aged ≤15 years were excluded from the study. Children aged <16 years ($n = 158$), pregnant women ($n = 3$), and critically ill persons ($n = 2$) were excluded from the evaluation. The power of the study was 0.90, with 7.5% margin of error and 95% confidence limit; the minimum required sample size was 171 persons. This convenient sample size of ≤200 was used for the study.

2.3. Study Design. The study was a cross-sectional survey, which evaluated the presence or absence of prediabetes, or diabetes mellitus and raised blood pressure (prehypertension) or hypertension onset in healthy adults.

2.4. Clinical Assessment. Age and demography were enquired from the participants, using a mercury sphygmomanometer; BP measurements were taken thrice, in persons with high BP; after a resting period of 15 minutes, the measurement was done again by the same field worker. Blood glucose concentration was determined in a subpopulation of participants, from blood obtained from a finger prick; random blood glucose or fasting blood glucose level was estimated using Randox® Glucometer. The attending physician clerked the individuals for further enquiries about symptoms or history of diabetes mellitus or hypertension and drug use.

2.5. Evaluation. Raised blood pressure or prehypertension was taken to be systolic blood pressure (SBP) of 120–139 mmHg or diastolic blood pressure (DBP) of 80–89 mmHg. Hypertension was defined as SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg [2, 35]. Prediabetes was defined as random blood glucose (RBG) of 140–199 mg/dl or fasting blood glucose of 100–125 mg/dl. Diabetes mellitus was defined as random blood glucose level of ≥200 mg/dl or fasting blood glucose of ≥126 mg/dl [6]. Others that are not within these categories were classified as normal.

2.6. Statistical Analysis. Data are expressed as mean ± standard deviation or proportions and were analyzed using GraphPad prism version 4 and SPSS version 16. Association between covariants and hypertension or diabetes was tested using correlation and regression models; likelihood ratio was estimated using Cox regression analysis. Chi-square test was used to compare proportions and p values of <0.05 were taken to indicate statistical difference.

3. Results

Overall, 182 individuals who met the inclusion criteria were included in the study. There were 141 (77%) females and 16 (8.7%) participants aged ≤20 years in the cohort. The mean age of the participants was 41.36 years (95% confidence interval 39.26–43.46, range 16–95 years), mean systolic blood pressure (SBP) of 119.4 mmHg (95% CI 116.3–122.5, range 90–200 mmHg), and mean diastolic blood pressure (DBP) of 78.4 mmHg (95% CI 76.4–80.3, range 50–120 mmHg).

3.1. Prevalence of Prehypertension and Hypertension. Prehypertension was present in 67 (36.8%) individuals from the cohort of which 72.3% were females and 3 were aged 20–23 years. Systolic blood pressure ≥ 140 mmHg was recorded in 29 (15.9%) individuals; 23 (79.3%) of them were females; SBP of ≥140 mmHg was not detected in participants <25 years old. Using standard population distribution of 50.4% females in Ota, gender adjusted prevalence of hypertension was 8.2% and 7.25% in females and males, respectively. This proportion was similar in males and females. Diastolic blood pressure ≥ 90 mmHg was present in 54 individuals (90% females). Similarly, DBP ≥ 90 mmHg was not detected in

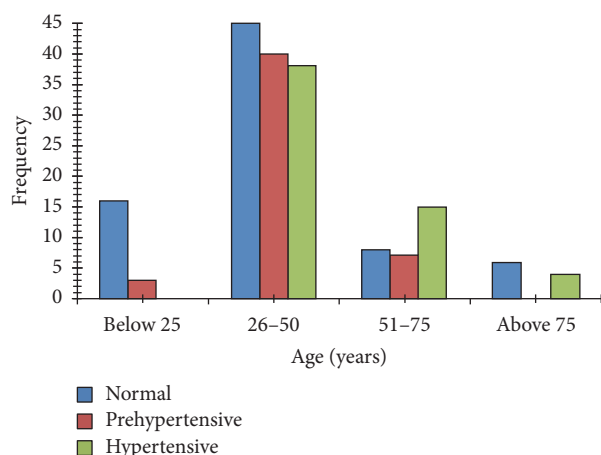


FIGURE 1: Prevalence of prehypertension and hypertension based on age in the study cohort. Prehypertension was defined as SBP 120–139 mmHg or DBP 80–90 mmHg and hypertension as SBP \geq 140 mmHg or DBP \geq 90 mmHg.

any participant <25 years. In total, 57 (31%) of the enrolled individuals had SBP \geq 140 mmHg and/or DBP \geq 90 mmHg, while 47% of them had both SBP \geq 140 and DBP \geq 90 mmHg. Figure 1 shows the age specific prevalence of prehypertension or hypertension in the cohort.

3.2. Prevalence of Prediabetes and Diabetes. Blood glucose test was done in a subpopulation of participants ($n = 79$). Random blood glucose \geq 100 mg/dl was detected in 45 participants, while prediabetes and diabetes were present in 3 and 4 individuals, respectively. None of the participants aged <20 years had prediabetes or diabetes.

3.3. Hypertension and Other Comorbidities. All 4 diabetic individuals also had hypertension comorbidity, while the 3 individuals with prediabetes had prehypertension. Few individuals in the cohort reported related symptoms such as headaches, weakness, and palpitations; this group is comprised mostly of adults older than 40 years. They were referred for appropriate medical follow-up.

3.4. Risk Assessment for Prehypertension and Hypertension. There was a significant positive correlation between prehypertension and age > 35 years (likelihood ratio 21.19, $p < 0.0001$) but not gender (likelihood ratio 0.85, $p = 0.58$) (Table 1). Likewise, there was a significant correlation between RBG and SBP ($r = 0.22$, $p = 0.04$), but not DBP ($r = 0.18$, $p = 0.10$). Prehypertension and blood sugar > 100 mg/dl showed no significant correlation ($p = 0.06$) but hypertension was significantly associated with blood sugar > 100 mg/dl (likelihood ratio 6.66, $p = 0.01$). The likelihood ratio for becoming hypertensive in the individuals aged >35 years was 22.56, $p < 0.0001$. This increases to 26.48 (odds ratio 8.72, 95% CI 3.45–22.02, $p < 0.0001$) in the presence of prediabetes. Figures 2(a) and 2(b) show the plots of age and SBP ($r = 0.48$, $p < 0.0001$) or DBP ($r = 0.36$, $p < 0.0001$), respectively, and Figure 3 shows regression plots for hypertensive and prehypertensive individuals aged <70 years with similar slope and interval in the two groups.

3.5. Symptoms. Although the study participants appeared healthy, frequently reported symptoms experienced in the past few weeks to months include palpitations, weakness, chest pain, and headaches.

4. Discussion

World Health Organization identified the African region as having the highest burden of hypertension, estimated at 46% in >25 year olds [3]. Hypertension as well as diabetes mellitus contributes significantly to the burden of noncommunicable diseases globally; about three-quarters of NCD deaths occur in low- and middle-income countries [3]. Africa bears higher disease burdens due to poor preventive and expensive health schemes and genetic susceptibilities to some diseases. In our cohort, only 31.9% individuals had blood pressure within normal range, and 91.1% had blood sugar concentration within normal range. Similar proportions of male and females in this setting presented with hypertension; other studies have reported varying gender proportions in studies carried out in Nigeria [32]. A third of our population had an undiagnosed underlying condition (31.3% were hypertensive and 5% were diabetic), and a similar proportion had prehypertension or prediabetes (36.8% and 3.4%, resp.). These rates fall within range from reported studies within and outside Nigeria [26, 28, 30, 36].

Predictions that about 75% of the world hypertensive population will emerge from developing countries by 2025 [4] is imminent. With Nigeria's population of over 200 million people, indeed there is a high population with undetected emerging burden of hypertension and reports have also shown that the highest number of people with diabetes and impaired fasting glucose lives in Africa [3, 15]. This population is at increased risk for cardiovascular disease. Hypertension and diabetes comorbidity rate of 10.5% was low in this population. Our study detected only 4 individuals with prediabetes who were also hypertensive in this cohort. It would appear that comorbidity of hypertension and diabetes or the preconditions are uncommon in this setting.

Regional variation in the prevalence of diabetes and hypertension and comorbidities due to cultural and lifestyle differences, level of awareness, and socioeconomic factors such as level of income and access to affordable health care is well established. The prevalence of diabetes in our study was very low; however, it is similar to rates of 3% in eastern Nigeria [31]. For hypertension, our study reported higher rate than another study [37], where a rate of 9.7% was diagnosed in southwest Nigeria, but similar to 37.8% rate in a clinic population reported in southern [11] and eastern Nigeria [28, 34]. Our findings are not significantly disparate with reports of other studies from Nigerian population as well as other African countries [5, 25, 32, 34, 37–41]. This finding calls for routine measures and intervention to improve case detection and diagnosis of hypertension to reduce the risk of progression to complications and associated deaths.

There was a strong correlation of age with prediabetes and prehypertension. Usually, these conditions precede the disease; although not all persons with the preconditions will develop the disease, they are implicated in developing

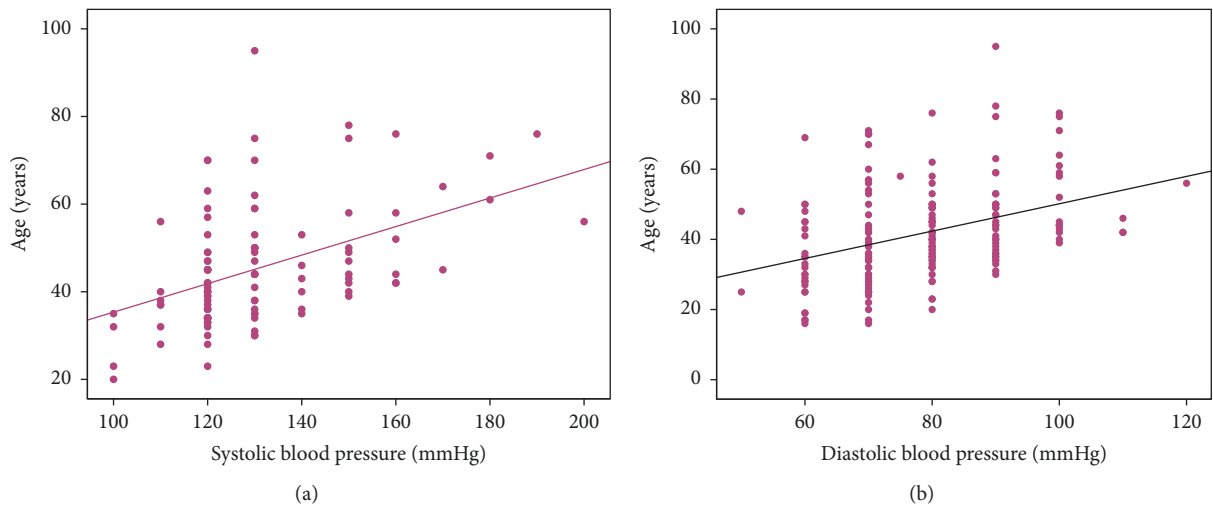


FIGURE 2: Scatter plots showing the distribution of systolic (a) ($r = 0.48, p < 0.0001$) and diastolic (b) blood pressure with age in the study cohort ($r = 0.36, p < 0.0001$).

TABLE 1: Risk assessment of prehypertension and hypertension in the cohort.

Covariants	Prehypertension odds ratio (95% CI)	Hypertension odds ratio (95% CI)	<i>p</i> value
Age (years)			
>35	4.49 (2.32–8.68)	6.34 (2.66–15.14)	<0.0001
≤35	1	1	
RBG (mg/dl)			
≥100	0.39 (0.14–1.08)*	3.32 (1.27–8.63)	0.01
<100	1	1	
Gender			
Male	0.85 (0.39–1.68)	0.75 (0.36–1.57)	>0.46
Female	1	1	

CI: confidence interval; * $p = 0.06$; RBG: random blood glucose.

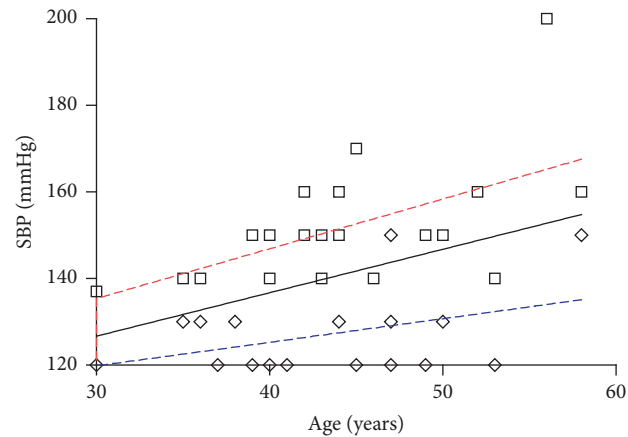


FIGURE 3: Comparison of regression plots of systolic blood pressure (SBP) and age in prehypertensive (blue dashed line), hypertensive (red dashed line), and all participants (black solid line) aged <60 years in the study cohort. Comparison of slopes: $t = 0.235, p = 0.816$; comparison of intercepts: $t = 0.002, p = 0.999$; test of coincidence, $F = 25.365, p < 0.0001$.

complications of the disease such as coronary heart disease and ischemic and hemorrhagic stroke [3, 19, 36]. Irrespective of lifestyle, screening and management of these diseases should be advocated in the adult age group. The likelihood for developing hypertension in prehypertensive population is high in the age group ≥ 35 years and consequences remain the same. NCDs caused 38 million premature deaths in 2012 and it is projected to increase to 52 million by year 2030 [3]; it is apparent that the undiagnosed population with hypertension and prehypertension of 68.1% will significantly increase soon and urgent interventions to reduce this emerging burden will help reduce morbidity and mortality caused by NCDs in LMIC. It is exigent to continue to detect the undiagnosed population and monitor trends and disease progress in affected persons for effective reduction of these public health problems.

Early detection and management of population with predisposing factors or the disease can reduce the risk of cardiovascular diseases [22–24]; however, regular screening for prehypertension or prediabetes or its knowledge as an

effective prevention measure is limited across Nigeria. In a population of hypertensives, 18% with prediabetes were detected in an African study [39] and 1.1% with prediabetes in eastern Nigeria [33]. In our population, a rate of 35.7% prehypertension was recorded in the present study. Prediabetes often precedes diabetes and the risk of progression to diabetes especially in hypertensive individuals [10, 13, 39]. Undiagnosed diabetes can progress to development of complications because these conditions are often asymptomatic. The implication of undiagnosed population in Nigeria is that if not managed, they will in the next few years contribute an increase to the already high burden of morbidity and mortality associated with NCDs in LMIC [3].

The study participants generally comprised adult farmers, traders, and low income semiurban dwellers who practice more of indigenous culture, thus a presumed healthy lifestyle. Causes of these diseases are multifactorial including older age, lifestyle, diet, and underlying genetic factors, which are modifiable by environmental and other factors for the development of either hypertension or diabetes [42]. There are limitations for the reported study; questionnaires were not given to the participants to harvest lifestyle or social status that could be assessed as covariants or determinants of the observed BP and blood sugar measurements. Our study did not also evaluate lipid profiles or other biochemical determinants that predispose one to cardiovascular diseases. Previous studies have reported obesity, dyslipidemia, sedentary lifestyle, and high alcohol consumption as some important attributable risk for the development of cardiovascular diseases in Nigeria [27, 37, 43, 44]. In this population, genetic risk factors were not determined; thus, further studies are required in this area to better predict persons at higher risks of the cardiovascular diseases and preventive strategies.

The high rate of prehypertension in this population supports predictions of future increase in prevalence of NCDs in LMICs in the future [3, 4, 14, 40]. Caution is required in the interpretation of the study outcomes, gender adjusted prevalence indicates a similar prevalence of risk of cardiovascular diseases in the area; this however is contrary to other reports of a variable prevalence of hypertension based on gender [32, 43]. Our study findings buttress the fact that there is need for urgent intervention for the emerging burden of NCDs especially when the individuals are in the prehypertensive stage. Figure 3 shows a similar pattern of regression (similar slope and intercept) in hypertensive and prehypertensive individuals although the lines appear almost parallel. If no actions are taken in this population, the imminent is bound to happen.

In conclusion, our findings indicate a low prevalence of prehypertension, prediabetes, and a high undetected population with cardiovascular diseases in the study area especially in the adult population. There were no hypertensive or diabetic persons aged <25 years, suggesting that early onset of diabetes mellitus or hypertension is not common in this region. Studies have reported effective reduction in cardiovascular diseases and outcomes of treatment in persons that were managed early [23, 24, 45]. Thus, regular screening in this age group is also advocated especially in individuals with

genetic susceptibility to the disease which can be detected early.

Conflicts of Interest

The authors hereby state that there are no conflicts of interest regarding this study.

Acknowledgments

The authors acknowledge the funding support of Covenant University Centre for Research Innovation and Discovery (CUCRID) and expertise of Covenant University Medical Centre team of the Community Development Impact Initiative group for the conduct of the research.

References

- [1] S. van de Vijver, H. Akinyi, S. Oti et al., "Status report on hypertension in Africa—consultative review for the 6th Session of the African Union Conference of Ministers of Health on NCDs," *The Pan African Medical Journal*, vol. 16, pp. 38–55, 2013.
- [2] World Health Organization, *Global Report on Diseases*, World Health Organization, Geneva, 2016.
- [3] World Health Organization, *Global Status Report on Non-Communicable Diseases*, World Health Organization, Geneva, ISBN 978 92 4 156485 4, 2015.
- [4] P. M. Kearney, M. Whelton, K. Reynolds, P. Muntner, P. K. Whelton, and J. He, "Global burden of hypertension: analysis of worldwide data," *The Lancet*, vol. 365, no. 9455, pp. 217–223, 2005.
- [5] L. H. Opie and Y. K. Seedat, "Hypertension in Sub-Saharan African populations," *Circulation*, vol. 112, no. 23, pp. 3562–3568, 2005.
- [6] American Diabetes Association, "Diagnosis and classification of diabetes mellitus," *Diabetes Care*, vol. 33, supplement 1, pp. S62–S69, 2010.
- [7] Centers for Disease Control and Prevention, "Vital signs: awareness and treatment of uncontrolled hypertension among adults - United States, 2003–2010," *Morbidity and Mortality Weekly Report*, vol. 61, no. 7, pp. 703–709, 2012.
- [8] World Health Organization, *World Health Statistics 2012 Report*, World Health Organization, Geneva, 2012.
- [9] American Diabetes Association (ADA), "Standards of medical care in Diabetes," *Diabetes Care*, vol. 37, pp. S14–S80, 2014.
- [10] J. R. Sowers, M. Epstein, and E. D. Frohlich, "Diabetes, hypertension, and cardiovascular disease: an update," *Hypertension*, vol. 37, no. 4, pp. 1053–1059, 2001.
- [11] B. C. Unadike, A. Eregie, and A. E. Ohwovoriole, "Prevalence of hypertension amongst persons with diabetes mellitus in Benin City, Nigeria," *Nigerian Journal of Clinical Practice*, vol. 14, no. 3, pp. 300–302, 2011.
- [12] B. M. Y. Cheung and C. Li, "Diabetes and hypertension: is there a common metabolic pathway?" *Current Atherosclerosis Reports*, vol. 14, no. 2, pp. 160–166, 2012.
- [13] T. W. Gress, F. J. Nieto, E. Shahar, M. R. Wofford, and F. L. Brancati, "Hypertension and antihypertensive therapy as risk factors for type 2 diabetes mellitus," *The New England Journal of Medicine*, vol. 342, no. 13, pp. 905–912, 2000.
- [14] S. Wild, G. Roglic, A. Green, R. Sicree, and H. King, "Global prevalence of diabetes: estimates for the year 2000 and projections for 2030," *Diabetes Care*, vol. 27, no. 5, pp. 1047–1053, 2004.

- [15] International Diabetes Federation, *IDF Diabetes Atlas*; Global, Seventh edition, 2015.
- [16] American Diabetes Association, "Classification and diagnosis of diabetes. In: Standards of Medical Care in Diabetes—2016," *Diabetes Care*, vol. 39, Supplement 1, pp. S13–S22, 2016.
- [17] B. Williams, "Insulin resistance: the shape of things to come," *The Lancet*, vol. 344, no. 8921, pp. 521–524, 1994.
- [18] World Health Organisation, *A Global Brief on Hypertension*, World Health Organisation, Geneva. WHO/DCO/WHO/2013.2, 2013.
- [19] J. A. Whitworth, "World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension," *Journal of Hypertension*, vol. 21, no. 11, pp. 1983–1992, 2003.
- [20] A. Menke, S. Casagrande, L. Geiss, and C. C. Cowie, "Prevalence of and trends in diabetes among adults in the United States, 1988–2012," *The Journal of the American Medical Association*, vol. 314, no. 10, pp. 1021–1029, 2015.
- [21] W. H. Herman and P. Zimmet, "Type 2 diabetes: An epidemic requiring global attention and urgent action," *Diabetes Care*, vol. 35, no. 5, pp. 943–944, 2012.
- [22] Diabetes Prevention Program Research Group, "Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin," *The New England Journal of Medicine*, vol. 346, no. 6, pp. 393–403, 2002.
- [23] S. J. Griffin, K. Borch-Johnsen, M. J. Davies et al., "Effect of early intensive multifactorial therapy on 5-year cardiovascular outcomes in individuals with type 2 diabetes detected by screening (ADDITION-Europe): a cluster-randomised trial," *Lancet*, vol. 378, pp. 156–167, 2011.
- [24] W. H. Herman, W. Ye, S. J. Griffin et al., "Early detection and treatment of type 2 diabetes reduce cardiovascular morbidity and mortality: a simulation of the results of the Anglo-Danish-Dutch Study of Intensive Treatment in People with Screen-Detected Diabetes in Primary Care (ADDITION-Europe)," *Diabetes Care*, vol. 38, no. 8, pp. 1449–1455, 2015.
- [25] World Health Organization, *Global Report on Diabetes*, World Health Organization, Geneva, 2013.
- [26] M. Pereira, N. Lunet, A. Azevedo, and H. Barros, "Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries," *Journal of Hypertension*, vol. 27, no. 5, pp. 963–975, 2009.
- [27] E. E. J. Iweala, S. N. Chinedu, I. S. Afolabi et al., "Propensity for diabetes and correlation of its predisposing factors in Ota, Nigeria," *Journal of Medical Sciences (Faisalabad)*, vol. 13, no. 8, pp. 809–813, 2013.
- [28] A. R. Isara and P. O. Okundia, "The burden of hypertension and diabetes mellitus in rural communities in Southern Nigeria," *Pan African Medical Journal*, vol. 20, 2015.
- [29] O. S. Ogah, I. Okpechi, I. I. Chukwuonye et al., "Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: a review," *World Journal of Cardiology*, vol. 4, no. 12, pp. 327–340, 2012.
- [30] D. Adeloye, C. Basquill, A. V. Aderemi, J. Y. Thompson, and F. A. Obi, "An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis," *Journal of Hypertension*, vol. 33, no. 2, pp. 230–242, 2015.
- [31] A. Chinedu and A. Nicholas, "Hypertension prevalence and body mass index correlates among patients with diabetes mellitus in Oghara, Nigeria," *The Nigerian Journal of General Practice*, vol. 13, no. 1, pp. 12–15, 2015.
- [32] J. T. Akinlua, R. Meakin, A. M. Umar, and N. Freemantle, "Current prevalence pattern of hypertension in Nigeria: A systematic review," *PLoS ONE*, vol. 10, no. 10, Article ID e0140021, 2015.
- [33] C. E. Ejike, N. K. Uka, and O. Nwachukwu, "Diabetes and pre-diabetes in adult Nigerians: Prevalence, and correlations of blood glucose concentrations with measures of obesity," *African Journal of Biochemical Research*, vol. 9, no. 3, pp. 55–60, 2015.
- [34] C. B. Nwatu, E. N. Ofoegbu, C. N. Unachukwu, E. E. Young, C. I. Okafor, and C. E. Okoli, "Prevalence of prediabetes and associated risk factors in a rural Nigerian community," *International Journal of Diabetes in Developing Countries*, vol. 36, no. 2, pp. 197–203, 2016.
- [35] The facts about high blood pressure, <http://www.heart.org/HEARTORG/Conditions/HighBloodPressure>.
- [36] F. P. Cappuccio, A. Barbato, and S. M. Kerry, "Hypertension, diabetes and cardiovascular risk in ethnic minorities in the UK," *British Journal of Diabetes & Vascular Disease*, vol. 3, no. 4, pp. 286–293, 2003.
- [37] O. O. Ogunleye, S. O. Ogundele, J. O. Akinyemi, and A. O. Ogbera, "Clustering of hypertension, diabetes mellitus and dyslipidemia in a Nigerian population: a cross sectional study," *African Journal of Medicine and Medical Sciences*, vol. 41, no. 2, pp. 191–195, 2012.
- [38] E. O. Asekun-Olarinmoye, P. O. Akinwusi, W. O. Adebimpe et al., "Prevalence of hypertension in the rural adult population of Osun State, southwestern Nigeria," in *Proceedings of the*, vol. 6, pp. 317–322, 2013.
- [39] N. Meme, S. Amwayi, Z. Nganga, and E. Buregyeya, "Prevalence of undiagnosed diabetes and pre-diabetes among hypertensive patients attending Kiambu district Hospital, Kenya: a cross-sectional study," *The Pan African Medical Journal*, vol. 22, p. 286, 2015.
- [40] V. Mohan, Y. K. Seedat, and R. Pradeepa, "The rising burden of diabetes and hypertension in southeast Asian and African regions: need for effective strategies for prevention and control in primary health care settings," *International Journal of Hypertension*, vol. 2013, Article ID 409083, 14 pages, 2013.
- [41] J. Kayima, R. K. Wanyenze, A. Katamba, E. Leontsini, and F. Nuwaha, "Hypertension awareness, treatment and control in Africa: a systematic review," *BMC Cardiovascular Disorders*, vol. 13, article 54, 2013.
- [42] N. Franceschini, E. Fox, Z. Zhang et al., "Genome-wide association analysis of blood-pressure traits in African-ancestry individuals reveals common associated genes in African and non-African populations," *American Journal of Human Genetics*, vol. 93, no. 3, pp. 545–554, 2013.
- [43] I. S. Afolabi, S. N. Chinedu, E. E. J. Iweala, O. O. Ogunlana, and D. E. Azuh, "Body Mass Index and Blood Pressure in a Semi-urban Community in Ota, Nigeria," *Food and Public Health*, vol. 5, no. 5, pp. 157–163, 2015.
- [44] S. O. Adediran, I. C. Okpara, S. O. Adeniyi, and K. A. Jimoh, "Hypertension prevalence in an Urban and Rural area of Nigeria," *Journal of Medicine and Medical Sciences*, vol. 4, no. 4, pp. 149–154, 2013.
- [45] A. Qureshi, M. F. Suri, J. F. Kirmani, and A. A. Divani, "Prevalence and trends of prehypertension and hypertension in United States: National Health and Nutrition Examination Surveys 1976 to 2000," *Medical Science Monitor*, vol. 11, no. 9, pp. 403–409, 1976.

